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PARASITES OF DOMESTIC AND WILD ANIMALS IN SOUTH AFRICA. XX. ARTHROPOD PARASITES OF THE CAPE MOUNTAIN ZEBRA *(EQUUS ZEBRA ZEBRA)*

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ABSTRACT

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The arthropod parasite burdens of 14 Cape mountain zebra *(Equus zebra zebra)*, shot for survey purposes in the Mountain Zebra National Park in the eastern Cape Province, were determined. Three species of *Gasterophilus* larvae and 9 ixodid tick species were recovered. Larvae of *Gasterophilus pecorum* were the most numerous of the fly larvae recovered and *Margaropus winthemi* was the most abundant tick.

Two horses examined in the park were infested with 3 species of *Gasterophilus* larvae and 7 species of ixodid ticks.

INTRODUCTION

The Cape mountain zebra *(Equus zebra zebra)* is one of the rarest mammals in the world (Penzhorn, 1979). Historically, these zebras have occurred consistently throughout the mountainous areas of the Cape Province, from Paarl Rock eastwards to the Amatolo Mountains in the Cathcart area and northwards to the Nuweveld, Zuurberg and Stormberg Mountains (Millar, 1970, cited by Smithers, 1983). The total population is now approximately 300 individuals (Penzhorn, 1984), the majority of which are concentrated in the Mountain Zebra National Park.

The Cape mountain zebra is 1 of 3 zebra species or subspecies found in southern Africa. The other 2 are Hartmann's mountain zebra *(Equus zebra hartmannae)*, found in certain mountainous regions in Angola and South West Africa/Namibia, and Burchell's zebra *(Equus burchelli)*, present on plains and in open savannah in most countries of the subcontinent. The parasites and diseases affecting Cape mountain zebra in the Mountain Zebra National Park have been listed by Young, Zumpt, Boomker, Penzhorn & Erasmus (1973), while the arthropod parasite burdens of Burchell's zebra and Hartmann's mountain zebra have formed the subject of 3 recent publications (Howard, 1981; Horak, De Vos & De Klerk, 1984; Horak, Biggs & Reinecke, 1984).

Because of the rarity of the cape mountain zebra and the lack of basic physiological, pathological and parasitological data for this equid, 13 stallions and a mare were shot in the Mountain Zebra National Park during the period February 1983–December 1984 and thoroughly examined. The present paper records the arthropod burdens of the 14 zebras shot for this purpose as well as those of 2 horses (1 gelding and 1 mare) in the park.

MATERIALS AND METHODS

The Mountain Zebra National Park (32° 15′ S, 25° 41′ E; Alt. 1200–1957 m) comprises an area 6 536 ha in extent and is situated 24 km south-west of Cradock in the eatern Cape Province. The physiography and climate of this park have been described by Penzhorn (1979).

A single zebra was shot during February 1983, 3 zebras were shot on each occasion during May and October 1983 as well as during March and July 1984 and a single zebra was shot during December 1984. Two horses, which had been allowed to roam with other horses in a valley bottom in the park during the day and were housed in a camp at night, were slaughtered during October 1983. After the zebras had been shot and the horses slaughtered, they were exsanguinated and their carcasses were transported to an outbuilding in the park where they were necropsied for parasite recovery.

At necropsy, *Gasterohilus* spp. larvae were recovered by the methods described by Malan, Reinecke & Scialdo (1981). Visible adult ticks were collected and preserved in 70 % ethanol, and the remaining ticks were collected by methods described by Horak, Meltzer & De Vos (1982). The ticks were counted as described by Horak, Potgieter, Walker, De Vos & Boomker (1983).

In the figures, mean parasite burdens were plotted when 3 animals were slaughtered at the same time, and total parasite burdens when only 1 zebra was shot. To obtain an idea of seasonal abundance, the parasite burdens have been plotted as though the animals had been shot consecutively during a single year from January–December, but the actual month and year of slaughter are indicated in the histograms.

Atmospheric temperature and rainfall were recorded in the park during the period of the survey.

RESULTS

Zebras

The total numbers of the various arthropods recovered and their prevalence are summarized in Table 1.

The larvae of 3 bot-fly species and the immature and/or adult stages of 9 ixodid tick species were recovered. *Gasterophilus pecorum* was the most numerous bot-fly larva recovered, and every zebra was infested with larvae of this fly. *Margaropus winthemi* was the dominant tick; all zebras were infested with this species as well as with *Hyalomma marginatum turanicum*, *Rhipicephalus evertsi evertsi* and *Rhipicephalus glabroscutatum*.

Gasterophilids

The abundance of *G. pecorum* during the various months in which zebras were shot is graphically illustrated in Fig. 1.

Second stage *G. pecorum* larvae were always present; the lowest numbers, however, were recovered during May 1983 and March 1984. Fairly large numbers of 3rd stage larvae were recovered at each occasion, with maximum numbers being present in the zebras examined during February and October 1983.

Ixodid ticks

The abundance of the 5 most numerous tick species is graphically illustrated in Fig. 2a–d. All stages of development of the 1-host tick *M. winthemi* are combined in the histogram (Fig. 2b).

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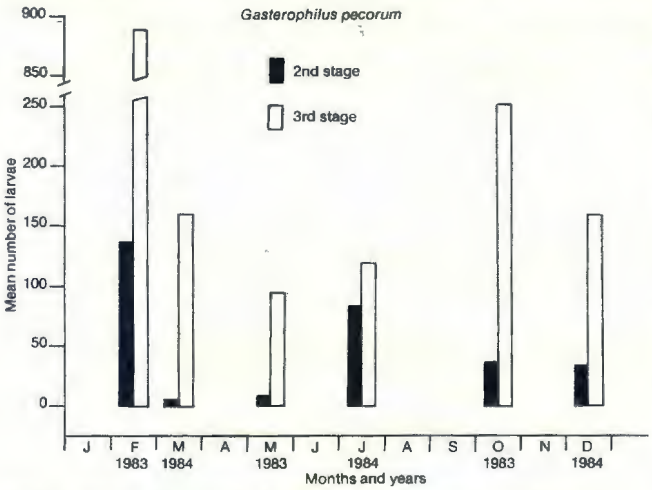

FIG. 1 The mean numbers of *Gasterophilus pecorum* larvae in Cape mountain zebras in the Mountain Zebra National Park

H. marginatum turanicum (Fig. 2a). No immature ticks were recovered. The adults preferred the summer months and were most numerous on the zebras during February 1983 and December 1984.

Hyalomma truncatum (Fig. 2a). Adults seemed to prefer the late summer and were most abundant on the zebra examined during February 1983.

M. winthemi (Fig. 2b). This tick preferred the winter and spring months. Massive numbers were recovered during July 1984 and substantial numbers during October 1983. The numbers recovered during autumn (May 1983) were considerably larger than those recovered during summer (February 1983 and March and December 1984). The ratio of larvae to nymphae to adults during autumn was 29,1:3,7:1,0, during winter, 4,2:2,0:1,0, and spring 1,0:3,3:9,3.

R. evertsi evertsi (Fig. 2c). Large numbers of all stages of development were present during the summer months of February 1983 and March 1984, and fairly large numbers of immature ticks during July 1984 (winter).

R. glabroscutatum (Fig. 2d). The largest numbers of immature stages were recovered during the late summer (March 1984), autumn (May 1983) and winter (July 1984). Adults were most abundant during spring (October 1983) and summer (February 1983, December 1984).

Horses

The mean numbers of arthropod parasites recovered from the 2 horses and 3 zebras slaughtered during October 1983 are summarized in Table 2.

The horses harboured 3 *Gasterophilus* species compared with 1 in the zebras. The horses also had considerably more adult *H. truncatum* and *Rhipicephalus* sp. (near *R. capensis)* than the zebras. The converse was true for *M. winthemi*.

Temperature and rainfall

The monthly mean minimum and maximum atmospheric temperatures and monthly rainfall during the period of the survey are graphically illustrated in Fig. 3.

The highest maximum temperatures were recorded during March and December 1983 and January–March 1984. The lowest minimum temperatures were recorded from June–August in each year. Total rainfall amounted to 380,3 mm and 260,4 mm during 1983 and 1984 respectively. The mean annual rainfall for this park is 398 mm.

DISCUSSION

Zebras

Gasterophilids

Gasterophilus intestinalis is a parasite of horses (Zumpt, 1965), and the single larva recovered from the zebras is probably due to infestation from horses kept in the park. Young *et al.* (1973) also recorded *G. intestinalis* in the Cape mountain zebras they examined in the park. *Gasterophilus nasalis* is a parasite of horses and zebras (Zumpt, 1965). Large numbers of this parasite have been recovered from Burchell's zebra in Zambia and in the north-eastern Transvaal (Howard, 1981; Horak, De Vos & De Klerk, 1984) and Hartmann's mountain zebra in Namibia (Horak, Biggs & Reinecke, 1984). The very small number recovered in the present survey indicates that this species may be on the verge of extinction in the park. If the level of infestation in the other zebras was the same as that in the zebras that were shot, the total zebra population would harbour fewer than 50 larvae of this species. This number of larvae could not be expected to maintain a viable population of flies.

TABLE 1 Arthropod parasites recovered from 14 Cape mountain zebras in the Mountain Zebra National Park

Arthropod species	Total numbers of arthropods recovered					Percentage of animals infested
Zebra bot-flies	1st stage larvae	2nd stage larvae	3rd stage larvae	Total		
Gasterophilus intestinalis	0	0	1	1		7,1
Gasterophilus nasalis	0	0	2	2		7,1
Gasterophilus pecorum	1	575	2 946	3 522		100,0
Ixodid ticks	Larvae	Nymphae	♂♂	♀♀	Total	
Amblyomma marmoreum	180	1	0	0	181	28,6
Hyalomma marginatum turanicum	0	0	201	44(10)	245	100,0
Hyalomma truncatum	0	0	174	31(1)	205	92,9
Ixodes sp.	32	0	0	0	32	7,1
Margaropus winthemi	56 816	27 737	13 353	4 353(640)	102 259	100,0
Rhipicephalus arnoldi	0	0	2	0	2	7,1
Rhipicephalus sp. (near *R. capensis*)	0	0	19	7	26	50,0
Rhipicephalus evertsi evertsi	6 384	4 797	619	201(35)	12 001	100,0
Rhipicephalus glabroscutatum	1 419	271	133	103(8)	1 926	100,0

( ) = Number of maturing female ticks, i.e. the idiosoma of *H. marginatum turanicum* and *H. truncatum* > 7,5 mm; *M. winthemi* > 4,5 mm; *R. capensis* and *R. evertsi evertsi* > 6,0 mm; *R. glabroscutatum* > 4,0 mm in length

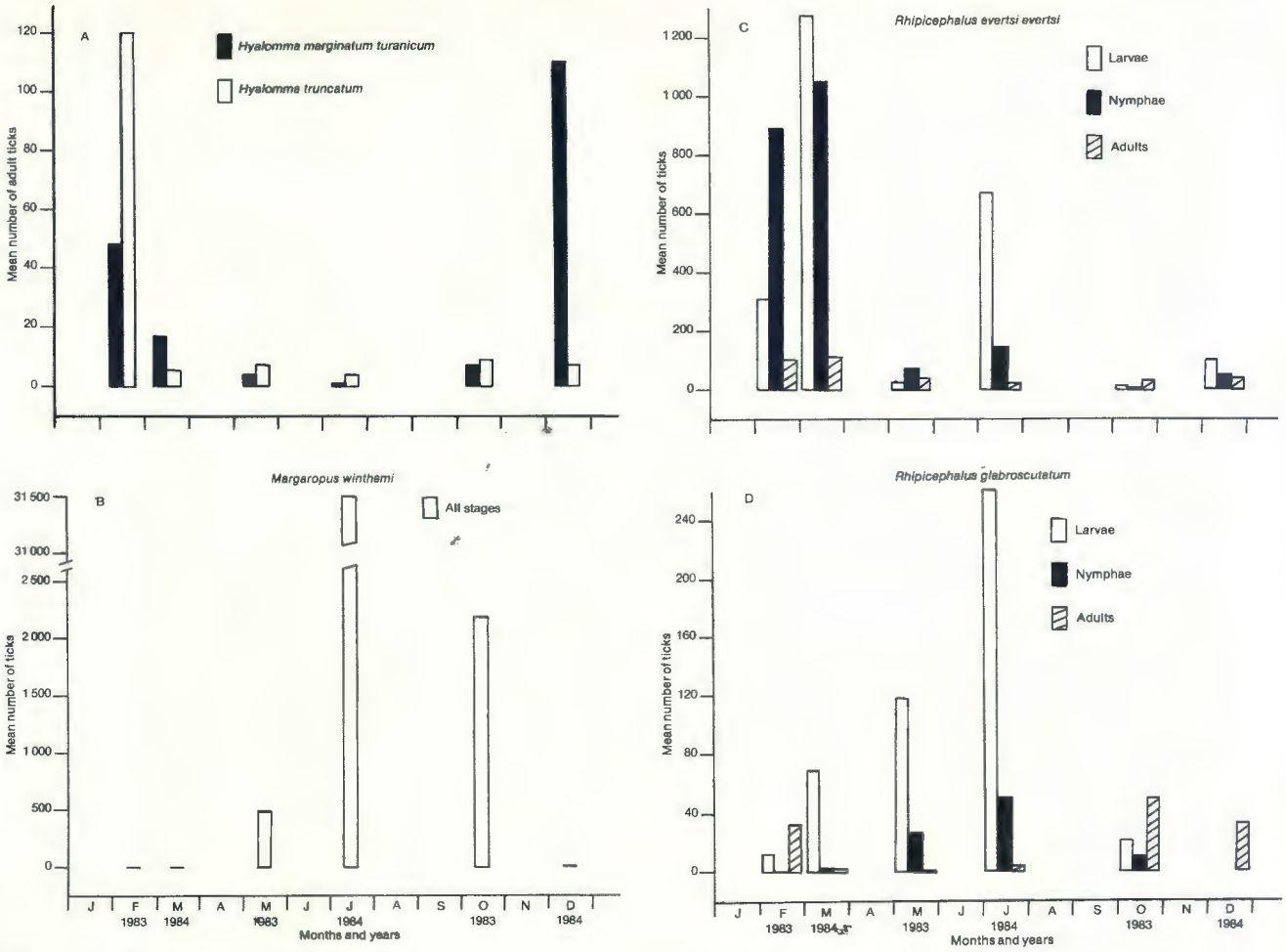

FIG. 2 The mean numbers of:
A. *Hyalomma marginatum turanicum* and *Hyalomma truncatum*
B. *Margaropus winthemi*
C. *Rhipicephalus evertsi evertsi*
D. *Rhipicephalus glabroscutatum*
on Cape mountain zebras in the Mountain Zebra National Park

In Zambia, Howard (1981) noted that the larvae of *G. pecorum* had disappeared from the Lochinvar population of Burchell's zebra during the past 20 years. This could have been due to a low initial level of infestation, but the dwindling numbers of the zebra population probably also played a significant role. The mean burden of 2nd and 3rd stage *G. pecorum* harboured by 35 Burchell's zebras examined by Horak, De Vos & De Klerk (1984) in the Kruger National Park was 129 larvae, while 12 Hartmann's mountain zebra examined in Namibia harboured a mean burden of 159 of these larvae. In the present survey the mean burden comprised 252 larvae.

Despite the fact that the gums around and between the molar teeth were carefully examined for larvae, no 1st

TABLE 2 Mean numbers of arthropod parasites recovered during October 1983 from 2 horses and 3 Cape Mountain zebras in the Mountain Zebra National Park

Arthropod species	Mean numbers of arthropods recovered							
	Horses				Mountain zebras			
Bot-flies	2st stage larvae	3nd stage larvae	Total		2nd stage larvae	3rd stage larvae	Total	
Gasterophilus intestinalis	0	20	20		0	0	0	
Gasterophilus nasalis	0	1	1		0	0	0	
Gasterophilus pecorum	32	448	480		38	253	291	
Ixodid ticks	Larvae	Nymphae	Adults	Total	Larvae	Nymphae	Adults	Total
Amblyomma marmoreum	7	0	0	7	0	0	0	0
Hyalomma marginatum turanicum	0	0	9	9	0	0	7	7
Hyalomma truncatum	0	0	42	42	0	0	9	9
Margaropus winthemi	48	0	0	48	160	537	1 491	2 188
Rhipicephalus arnoldi	0	0	0	0	0	0	0,7	0,7
Rhipicephalus sp. (near *R. capensis*)	0	0	115	115	0	0	2,7	2,7
Rhipicephalus evertsi evertsi	6	2	17	25	12	6	37	55
Rhipicephalus glabroscutatum	9	1	47	57	21	10	49	80

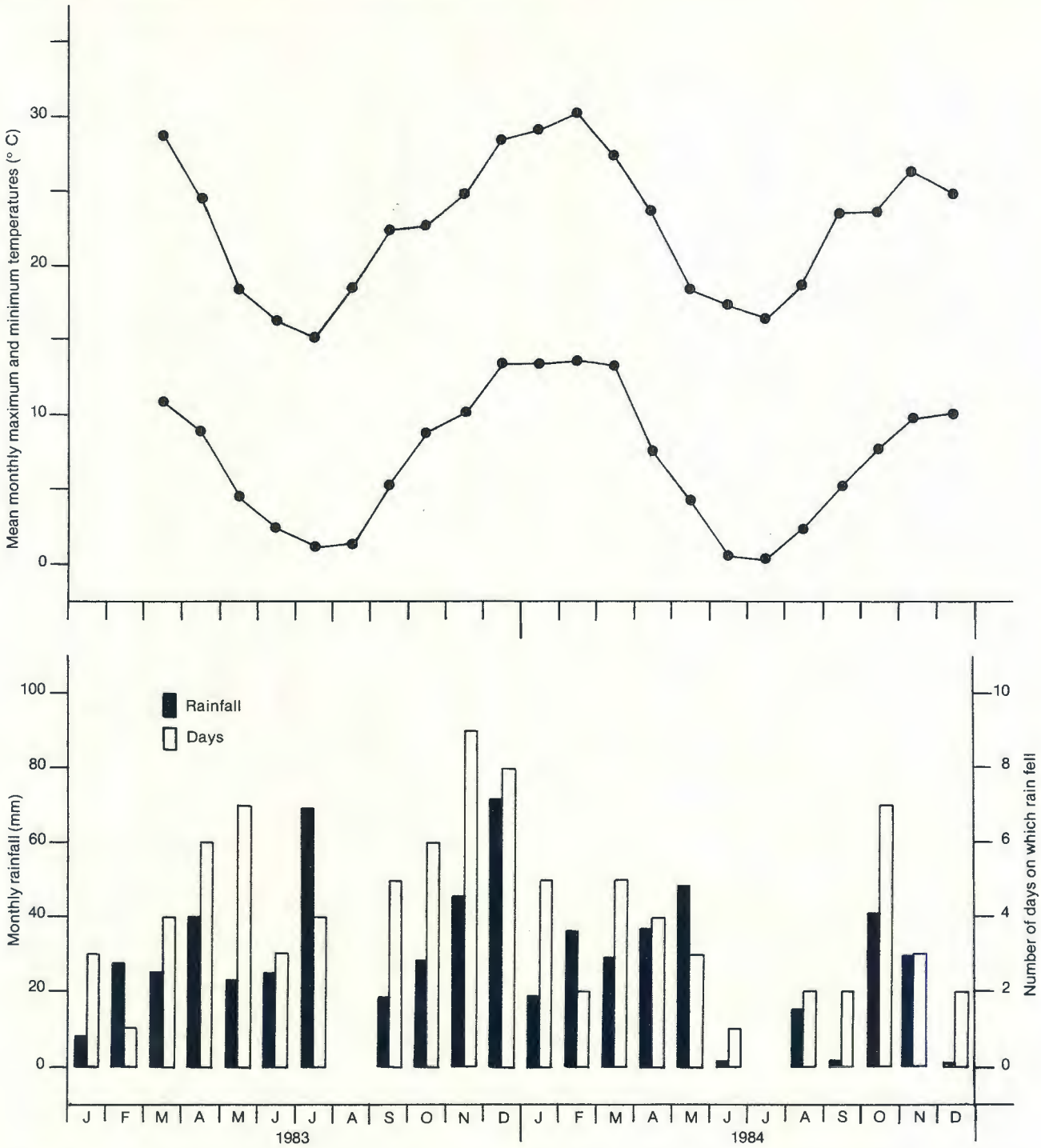

FIG. 3 Monthly mean minimum and maximum atmospheric temperatures and monthly rainfall in the Mountain Zebra National Park (atmospheric temperatures were not recorded during January and February 1983)

stage and only 4 2nd stage *G. pecorum* larvae were recovered from this site. The tongues were also examined for larvae, and only 2 2nd stage *G. percorum* larvae were recovered. Larvae of this species thus seem to prefer to moult to the 2nd stage in other sites than those examined before attaching in the pharyngeal region.

Fairly clear patterns of seasonal abundance could be determined for *G. pecorum* in Burchell's zebras and in Hartmann's mountain zebras (Horak, De Vos & De Klerk, 1984; Horak, Biggs & Reinecke, 1984). No such pattern could be established in the present survey, but this may have been due to the long intervals between slaughter.

It is interesting to speculate whether the *G. pecorum* population survived in the Cape mountain zebra population in the Cradock region when the latter's numbers had dwindled to about 40 during 1950 or whether it had become extinct and then re-established by cross-infestation from horses in the park. Because the park is small, cross-infestation from horses kept on surrounding farms is always possible, although this is probably unlikely.

No oestrid larvae were recovered from the nasal passages or sinuses of the zebras.

Ixodid ticks

Young *et al.* (1973) recorded 4 and Penzhorn (1984) 5 ixodid tick species from zebras in the park. To their lists can now be added *Amblyomma marmoreum, H. marginatum turanicum, H. truncatum, Ixodes* sp. and *Rhipicephalus arnoldi*. Horak *et al.* (1983) examined 2 gemsbok in the park during 1979 and, with the exception of *Ixodes* sp. and *R. arnoldi,* recovered the same tick species as those found on the zebras in the present survey. The latter 2 ticks should, however, be regarded as accidental infestations on the zebras. Immature *Ixodes* sp. and immature and adult *R. arnoldi* prefer red rock rabbits as hosts, and fairly large numbers have been recovered from these animals in the park (Horak, Fourie & Novellie, unpublished data, 1984).

A. marmoreum. This tick should also be regarded as an accidental parasite of the zebras. Adults and immatures normally prefer tortoises, but the immatures may also be found in small numbers on a variety of mammals and birds (Norval, 1975).

Hyalomma spp. Adults of these ticks seldom occur in large numbers and the burdens recovered from the zebras during the summer months can be regarded as substantial. A total of only 26 adult *H. truncatum* was recovered from 33 Burchell's zebra examined by Horak, De Vos & De Klerk (1984) in the Kruger National Park, while Horak, Biggs & Reinecke (1984) recovered a total of 105 adult *Hyalomma marginatum rufipes* and 6 adult *H. truncatum* from 12 Hartmann's mountain zebra in Namibia. The immature stages of these ticks may occur in large numbers on hares (Clifford, Flux & Hoogstraal, 1976).

The summer abundance of adult ticks corresponds to that noted by Londt, Horak & De Villiers (1979) and Horak (1982) for *H. marginatum rufipes* and *H. truncatum* on cattle in the northern Transvaal. In both their surveys they recorded an increase in the numbers of *H. marginatum rufipes* earlier in summer than for *H. truncatum,* which only reached peak numbers during January and February. Despite the irregular slaughter intervals, a similar pattern is evident for *H. marginatum turanicum* and *H. truncatum* in the present study.

Margaropus winthemi. Information on the biology of this 1-host tick has been given by Theiler & Salisbury (1958), Theiler (1962) and Howell, Walker & Nevill (1978). They state that it is essentially a winter tick and is most commonly found on horses, though it also attacks cattle. Geographically, it is probably confined to the Republic of South Africa and to Lesotho, preferring higher lying regions with cold winters. Young *et al.* (1973) have noted large infestations on Cape mountain zebra in the Mountain Zebra National Park, and Horak *et al.* (1983) have recovered small numbers from gemsbok in the same park during the summer.

The findings of the present survey confirm that this tick prefers the winter. During July 1984, the 3 zebras examined each had burdens exceeding 25 000, while the 5 zebras examined during the summer months of February (1983), March (1984) and December (1984) had burdens consisting of fewer than 15 *M. winthemi*. The high ratio of larvae to other stages of development during the autumn (May 1983) is an indication of newly-acquired infestation after the virtual absence of infestation during the summer. The larval, nymphal and adult ratios during winter (July 1984) were fairly similar to those of *Boophilus decoloratus* (also a 1-host tick) occurring on Burchell's zebra throughout the year in the Kruger National Park (Horak, De Vos & De Klerk, 1984). The ratio of adult to immature stages of *M. winthemi* during spring (October 1983) is an indication that no new infestation was taking place and that the existing infestation was maturing and would subsequently virtually disappear in the summer.

The seasonal prevalence of this tick suggests that only 1 life cycle is completed annually. The population probably survives off the host from spring until the following autumn or winter, either as engorged females or as eggs.

Penzhorn (1984) summarized the aetiological diagnoses of mortality in a number of zebras in the park. Of the 22 zebras for which mortality dates were fairly accurately known, 20 died during winter (19 of these between July and September). He states that the late winter is a critical period for survival, probably because of the deteriorating quality of the forage and the excessively cold weather. To these stressful conditions can now be added the debilitating effect of large tick burdens.

R. evertsi evertsi. The Cape mountain zebra is an excellent host, harbouring, as it does, large numbers of all stages of development. The presence of larvae, nymphae and adults during all seasons is an indication that the life cycle in the Cradock region can continue throughout the year and that more than 1 generation can probably be completed annually. Burchell's zebra is also a good host of this tick, while Hartmann's mountain zebra may harbour large numbers of *Rhipicepphalus evertsi mimeticus* (Horak, De Vos & De Klerk, 1984; Horak, Biggs & Reinecke, 1984).

R. glabroscutatum. The vast majority of immature and adult ticks were recovered from around the feet and from the lower legs of the zebras. The ratio of larvae to nymphae of this 2-host tick indicates that the zebras are not good hosts of the immature stages because of the marked drop in numbers between the larval and nymphal stages of development. Adult ticks of this species are never particularly abundant on any host species (Knight & Rechav, 1978; MacIvor & Horak, 1984).

Knight & Rechav (1978) found that adult *R. glabroscutatum* were most abundant on kudu in Valley Bushveld in the Grahamstown region of the eastern Cape Province from September–January. MacIvor & Horak (1984) recorded the largest numbers of immature ticks from goats in Valley Bushveld in the Uitenhage region of the eastern Cape Province from April–August, and adults from September–December. These times do not differ markedly from the period of March–July for immatures and October–February for adults recorded in the present survey, particularly if the irregular intervals of collection are taken into consideration.

Horses

Both horses were infested and although the number of *G. intestinalis* recovered was small, this confirmed Zumpt's (1965) observation that this is a parasite of horses and not of zebras. The fact that a total of only 2 *G. nasalis* larvae were recovered (both of these from 1 horse) is furhter evidence that this species is possibly on the verge of extinction in the park. Both horses harboured considerably more *G. pecorum* larvae than did any of the zebras slaughtered at the same time. Whether this was fortuitous or due to host preference or host habitat difference, could not be determined in this survey.

The largest differences in tick burdens between the horses and zebras were evident for *H. truncatum, M. winthemi* and *Rhipicephalus* sp. (near *R. capensis).* We ascribe these differences to the habitats occupied by the animals rather than to host preference.

The scrub hare *(Lepus saxatilis)* is an excellent host of immature *Hyalomma* spp., while certain rats and mice are good hosts of immature *Rhipicephalus* sp. (near *R. capensis)* (Horak, Fourie & Novellie, unpublished data, 1984). These small mammals seem to be more abundant

in the lower-lying valleys of the park than on the exposed plateau, and thus the horses, which were kept in a valley, would be more likely to be exposed to heavier infestations of the latter 2 ticks than the zebras. *M. winthemi* appears to favour colder, high-lying areas, and consequently the zebras, which grazed on the high plateau within the park, would be more likely to be exposed to infestation than the horses in the valley.

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